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Two-Stage Agricultural Import Demand Models
Theory and Applications

by

Colin Carter, Richard Green
and Daniel Pick*

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*Associate Professor, Professor, and Postgraduate Research Associate, respectively; Department of Agricultural Economics, University of California-Davis. Names of authors are listed in alphabetical order and senior authorship is not assigned.

Correspondence or requests for additional copies of this paper should be addressed to:

Dr. Nicole Ballenger
USDA/ERS/ATAD
624 NYAVEBG
1301 New York Ave. N.W.
Washington, D.C. 20005-4788

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Abstract

The Armington trade model distinguishes commodities by country of origin and import demand is determined in a separable two-step procedure. The Armington framework has been applied to numerous international agricultural markets with the objective of modelling import demand.

The purpose of this paper is to test the Armington assumptions of homotheticity and separability with data from the international wheat market. The empirical results overwhelmingly reject these assumptions. This has important implications for international trade modelling

TWO-STAGE AGRICULTURAL IMPORT DEMAND MODELS: THEORY AND APPLICATIONS

The responsiveness of import demand to international price changes is an important topic in applied international agricultural trade research. Elasticities of import demand have long been used to estimate the effects of trade barriers and examine trade policy options. During the 1985 debate over the Food Security Act, the price responsiveness of import demand for U.S. grain was the single most important issue (Thompson, 1987). Ultimately, the U.S. government decided that the import demand for U.S. grain sales was price responsive. Import demand elasticities in excess of unity were then used to justify lowering U.S. loan rates (i.e., floor prices) as a means of regaining market shares in the international grain markets (FAPRI; Myers).

In any trade study, empirical estimates of import demand elasticities are partially predicated on the particular specification chosen for the trade model. A number of different model specifications have appeared in the literature and these are well documented in two separate surveys by Sarris (1981) and Thompson (1981). The Armington model is one specification which has been very popular. It is a disaggregate model which distinguishes commodities by country of origin and import demand is determined in a separable two-step procedure. The Armington approach permits the calculation of cross-price elasticities between all exporters from estimates of the aggregate price elasticity for imports, the elasticity of substitution and trade shares. The ease of use and flexibility are two reasons why the Armington model has been applied so often to international agricultural markets. Of course, another important reason is that the Armington model often gives results which are judged successful because of statistical significance. The Armington approach has been applied to modeling agricultural trade by Abbott and Paarlberg; Babula; Collins; Figueroa and Webb; Grennes, Johnson and Thursby; Penson and Babula; Sarris (1983); Suryana; and Wells.

The purpose of this paper is to test the Armington assumptions of homotheticity and separability. These assumptions are tested with data from the international wheat market. Import demand functions for wheat are estimated for China, Japan, Brazil, Egypt, and U.S.S.R. It is more appropriate to consider the wheat market within the Armington framework than either the corn, soybeans, or cotton market. Unlike these other agricultural products, wheat is supplied by several exporting countries and there are significant differences between different types of wheat. For example, Canadian wheat is of a much higher quality than wheat from the EC. The almost ideal demand system (AIDS) of Deaton and Muellbauer is used in the second stage of the two-stage budgeting procedure to test the restrictive assumptions implied by the Armington model. The empirical results overwhelmingly reject the separability and homotheticity restrictions in the import demand functions. In other words, this paper finds that the Armington assumptions are inappropriate. These results have important implications for international trade modeling. They strongly suggest using trade models which do not rely on the Armington assumptions. Fortunately, more flexible trade specifications have been developed recently.

Two-Stage Theoretical Models

In general, a two-stage budgeting procedure assumes that consumers can allocate their total expenditures in two stages (Deaton and Muellbauer). In the first stage, total expenditure is allocated over broad groups of goods, while in the second stage group expenditures are allocated over individual commodities. It is well known that a necessary and sufficient condition for the second stage of a two-stage budgeting procedure is weak separability of the direct utility function over broad groups of goods. However, weak separability imposes restrictions on consumer behavior. First, the marginal rate of substitution between two goods from the same group is independent of the consumption of goods in other groups. For example, if separability is assumed between import sources, as in the Armington model, then the Japanese substitution between Canadian and U.S. wheat is independent of the consumption of Australian wheat. This seems unrealistic. Second, the substitution effects between goods in different groups is limited. A price change of a commodity in one group affects the demand for a commodity in another group only through the group income effect. Third, separability implies a restrictive relationship between price and income effects. More specifically,

$$S_{ij} = \mu_{GH} \frac{\partial q_i}{\partial x} \cdot \frac{\partial q_j}{\partial x} \tag{1}$$

where S_{ij} is the compensated cross-price affect, μ_{GH} is a constant depending on groups G and H, q_i and q_j are quantities of the i^{th} and j^{th} goods where i and j belong to different groups and x is total expenditure.

However, if the two-stage budgeting procedure is consistent with a one-stage utility optimization procedure then either (1) the utility function is additive over groups or (2) the subaggregator functions (in stage 2) must be homothetic (Gorman). It should be noted that these conditions hold if a single group price is required for each aggregate of goods or a group. Segerson and Mount developed a more flexible consistent model than the standard two-stage budgeting procedure and under more general conditions by allowing the existence of more than one price index to represent the price movements of each group.

In the context of a trade allocation model, the two-stage budgeting procedure can be explained as follows. In the first stage an importer's total imports of a particular commodity can be expressed as:

$$M = M(Y, P_W, P_O, Z_1) \tag{2}$$

where M is total imports of the commodity (e.g., wheat); Y is the importer's real national income; P_W is an index of the real import price of wheat; P_O is an index of the real import price of other goods (or aggregate goods) and Z_1 is a vector of other exogenous variables.

In the second stage, the import of the commodity is divided up amongst the various suppliers of the product to yield

$$M_i = M_i(M, P_1,\ldots,P_n, Z_2), \quad i=1,\ldots,n \tag{3}$$

where M_i represents the imports of wheat from country i ($i = 1,\ldots,n$), P_i represents the real export price of wheat supplied by the ith export nation and Z_2 is a vector of other exogenous variables.

How does Armington's model relate to the above two-stage budgeting procedure? The first two stages of Armington's framework are, in general, equivalent to those described above. That is, in the first stage the importer decides how much of a particular commodity to import (equation (2)). In the second stage (equation (3)), given the total amount imported, the importer decides how much to import from each supplier. Thus, the implications of weak separability apply to the possible substitution effects within and between commodity groups. However, the Armington approach further assumes homotheticity of the sub-utility or within-group utility functions. This implies that an importer's market shares are independent of group expenditures. Consequently, all expenditure elasticities within a group are equal and an importer's market shares only change with respect to price changes. This is contrary to empirical evidence related to import demand behavior for agricultural products. In addition, the Armington model uses a CES within-group specification. That is,

$$w_{ij} = b_{ij}{}^{\sigma_i}\left(\frac{P_{ij}}{P_i}\right)^{1-\sigma_i} \tag{4}$$

where w_{ij} is the market share of the i^{th} importer from source j, b_{ij} is a constant, P_{ij} is the price of the commodity from the j^{th} source, P_i is the i^{th} market price index depending only on the within-group prices and σ_i is the constant elasticity of substitution parameter. The CES specification implies separability between different import sources. Thus, the Armington framework implies that in the second stage (within-group allocations) market shares do not vary with expenditures and that different import sources are separable. The focus of this paper is on the consequences of the Armington assumptions on the properties of the second stage or within parameter estimators. Both of these assumptions will be tested within the context of the AIDS.

It can be shown that there exist group expenditure functions in the two-stage budgeting procedure that give rise to the AIDS specification (Deaton and Muellbauer). The budget share of imports from source i using the AIDS is given by

(5) $$w_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln(M/P), \quad i = 1,\ldots,n$$

where the log of the price deflator is

(6) $$\ln P = \alpha_0 + \sum_k \alpha_k \ln p_k + \tfrac{1}{2} \sum_{j}\sum_{k} \gamma_{kj} \ln p_k \ln p_j,$$

M is total expenditure on imports and p_j are prices of imports from source j.

Adding-up requires that

(7) $$\sum_i \alpha_i = 1, \quad \sum_i \gamma_{ij} = 0 \text{ and } \sum_i \beta_i = 0.$$

Homogeneity requires that

(8) $$\sum_j \gamma_{ij} = 0, \quad i = 1,\ldots,n$$

and symmetry requires that

(9) $$\gamma_{ij} = \gamma_{ji}, \quad i,j = 1,\ldots,n.$$

For a more detailed discussion of the AIDS, see Deaton and Muellbauer. The aggregate price deflator in (6) can be approximated by Stone's index:

$$\ln P^* = \sum_k w_k \ln p_k. \tag{10}$$

For a discussion of the effects of this substitution on the properties of the subsequent estimators, see Blanciforti and Green.

The test for homotheticity in the AIDS import share equations is equivalent to testing that all the β_i are zero. This implies that the import shares are independent of the total import level (see equation (5)). To test for separability between import sources, we follow Winters and test whether the particular price from the import source contributes anything to the otherwise complete allocation model. This condition is a necessary consequence of separability. In general, one of the implications of separability over groups is that the within-group demand functions only contain prices of commodities within that group. Thus, for each import source we estimated an AIDS excluding it and then tested whether its price had any influence on the included import shares. In every case, in order to make the models tractable, we abstract from the problem of aggregation over goods.

Empirical Results

Wheat import demand share equations using the AIDS were estimated for five importing nations: China, Brazil, Egypt, U.S.S.R. and Japan. These countries accounted for approximately 51 percent of world wheat imports in 1984/85. Annual data for prices and trade flows were used in the empirical analyses. The data were obtained from the International Wheat Council, World Wheat Statistics. The number of observations for each of the importing regions varied based on the availability of data and import developments for that particular country. For Japan, the estimation period covered the years 1960/61-1984/85. Brazil imports wheat from three sources: Argentina, Canada and the United States. However, Brazil started importing wheat from Canada only in 1970/71 and therefore the estimation period for Brazil included the years 1970/71-1984/85. Egypt has four primary import sources: Australia, Canada, the EEC and the United States. The data included the period 1971/72-1984/85. Imports of wheat by the Soviet Union varied dramatically over the years. The United States became a major source for the Soviets during the 1972/73 marketing year. Argentina, Australia and the EEC became major wheat exporters to the Soviet Union during the early 1980s. Canada has been the only major foreign source of wheat supply to the Soviet Union since the 1960s, although the quantity imported varied considerably from year to year. The data used for the U.S.S.R. included the period of 1972/73-1984/85. The same period of analysis was used for the People's Republic of China (PRC). Although Australia and Canada have been exporting wheat to the PRC since the 1960s, the United States did not export wheat to China until the early 1970s.

The price data used in the analyses for the respective periods were the export prices reported by the International Wheat Council. The import demand models of equation (3) were estimated by seemingly unrelated regression (SUR) techniques with symmetry and homogeneity restrictions imposed. The SUR estimators have the same asymptotic properties as maximum likelihood estimators. Due to the adding-up condition, the contemporaneous covariance matrix is singular. Thus, the standard procedure of arbitrarily deleting an equation was employed. The estimates are invariant to the equation deleted when the cross-equation restrictions are not imposed in the first step of the estimation procedure (Segerson and Mount).

Since the primary focus of the paper is to examine the usefulness of the Armington model, only the tests of separability and homotheticity are reported. In a SUR framework, the following statistic was used to test the validity of the linear restrictions implied by homotheticity and separability:

$$(11)\quad \lambda = \{[(y-X\hat{\beta}^*)'(\Sigma^{-1} \otimes I)(y-X\hat{\beta}^*) - (y-X\hat{\beta})'(\Sigma^{-1} \otimes I)(y-X\hat{\beta})]/ [(y-X\hat{\beta})'(\Sigma^{-1} \otimes I)(y-X\hat{\beta})]\} \cdot [(MT-K)/J]$$

where $\hat{\beta}^*$ is the restricted SUR estimator, $\hat{\beta}$ is the unrestricted SUR estimator of the coefficients, Σ is the contemporaneous covariance matrix, M is the number of equations, T is the number of observations, K is the number of explanatory variables in each equation, and J is the number of restrictions (Judge <u>et al</u>., p. 327). Under the null hypothesis ($R\beta=r$), i.e., assuming the restrictions hold, λ has an F distribution with MT-K and J degrees of freedom. When Σ is unknown and replaced by its estimated value from the residuals, then λ converges to a χ^2 distribution. Theil recommends using this statistic using an F distribution and provides a large sample justification for its use (Theil). Asymptotically equivalent tests are the likelihood ratio procedure, Wald's chi square statistic or the LM test.

The test results are reported in Tables 1 through 6. In every case, the first column of each table contains the import source which is being tested to determine whether it is separable from the other (included) import sources. For example, from Table 1, in the first column (under I) imports from Australia are being tested to determine whether they are separable from imports from the United States, Canada or Argentina. The countries listed below Australia, for example, under (a)--the United States and Canada--are the countries included in the estimations. Recall that one equation is deleted because of the singular residual covariance matrix and in this case it is Argentina. Similar interpretations hold for the remainder of the tables.

First, consider the homotheticity constraint. Column two of each table reports the test statistic. For Japan (Table 5), the restriction is rejected in every case; for Russia (Table 4), the constraint is rejected in 18 out of 20 cases; for Brazil and Egypt (Tables 2 and 3) only one time in each case; and for China (Table 1), homotheticity is rejected at the 5 percent level of significance in 5 of 12 cases. Thus, homotheticity which implies unitary income elasticities is overwhelmingly rejected for some countries (Japan and Russia) and is frequently rejected for others (China).

With respect to separability over import sources, consider column three in each table. The coefficient, δ_i, is the log price coefficient on the import source being tested. For each import source being tested the AIDS was estimated including it and then tested to determine whether its price had any influence on the remaining import shares. For China (Table 1), in 4 of 12 cases, the price coefficient was found to be statistically significant. For Brazil (Table 2), 2 of 6 prices were significant; for Egypt (Table 3), 3 of 6 cases; for the U.S.S.R. (Table 4), 14 of 20 cases were significant at the 5 percent level; and for Japan (Table 5), all 6 price coefficients were significantly different from zero at the 5 percent significance level. Thus, in many cases the assumption implied by the Armington model; namely, separability over import sources, was strongly rejected.

Finally, in column 4 of each table homotheticity and separability were tested jointly. In the vast majority of cases, these joint constraints were rejected. Consequently, the Armington assumptions are rejected too frequently to be imposed automatically in applied trade research.

Conclusions

This paper tested the assumptions of the Armington trade model in the context of the international wheat market. It is concluded that alternative import demand functions need to be utilized which do not impose the unrealistic restrictions of the Armington model. The empirical results strongly suggest more flexible trade allocation models. What are some alternatives that might be an improvement over the Armington model? We provide two alternatives. First, the AIDS model was estimated although the results are not reported in this paper. The AIDS structural coefficient estimates yielded too many implausible results such as positive own-price elasticities, etc. that prevents us from recommending this specification without much more investigation. Second, the non-homothetic two-stage model developed by Segerson and Mount appears to hold a great deal of promise for trade allocation models. To our knowledge, this rather flexible model has not yet been applied to import demand models. The empirical results from using this model may provide some interesting alternative price elasticities and other useful information for trade analysts that do not implicitly impose the restrictive constraints of the Armington specification.

REFERENCES

Abbott, P. and P. Paarlberg, "Modeling the Impact of the 1980 Grain Embargo." Embargoes, Surplus Disposal and U.S. Agriculture, Staff Report No. AGES860910, Ch. 11, U.S. Dept. Agr., Econ. Res. Serv., November 1986.

Armington, P. S., "A Theory of Demand for Products Distinguished by Place of Production," IMF Staff Papers, XVI, (1969): 159-176.

Babula, R., "An Armington Model of U.S. Cotton Exports," J. of Agr. Econ. Res., (1987):12-22.

Blanciforti, L. and R. Green, "An Almost Ideal Demand System Incorporating Habits: An Analysis of Expenditures on Food and Aggregate Commodity Groups," Review of Econ. & Stat., 45(1983): 511-515.

Collins, K. J., "An Economic Analysis of Export Competition in the World Coarse Grains Market: A Short-Run Constant Elasticity of Substitution Approach," Ph.D. dissertation. North Carolina State University, Raleigh, NC, 1977.

Deaton, A. S. and J. Muellbauer, "An Almost Ideal Demand System," Amer. Econ. Rev. 70(1980):312-26.

Figueroa, E. and A. J. Webb, "An Analysis of the U.S. Grain Embargo Using a Quarterly Armington-Type Model." Embargoes, Surplus Disposal, and U.S. Agriculture, Staff Report No. AGES 860910, Ch. 12, U.S. Dept. Agr., Econ. Res. Serv., November 1986.

Food and Agricultural Policy Research Institute (FAPRI), "The Food Security Act of 1985 One Year Later: Implications and Persistent

Problems," FAPRI Staff Report #3-86, University of Missouri-Columbia and Iowa State University, December 1986.

Gorman, W., "Separable Utility and Aggregation," Econometrica, 27(1959): 469-481.

Grennes, T., P. R. Johnson, and M. Thursby, The Economics of World Grain Trade, New York: Praeger Publishers, 1977.

Judge, G., R. Hill, W. Girffiths, H. Lutkepohl, and T. C. Lee, Introduction to the Theory and Practice of Econometrics, New York: John Wiley and Sons, 1982.

Myers, P. C., Deputy Secretary of Agriculture, USDA, Statement Prepared for Hearings on "Policy Alternatives to the Food Security Act of 1985," U.S. Congress, House Agric. Committee, 1987.

Penson, J., Jr. and R. Babula, "Japanese Monetary Policies and U.S. Agricultural Exports," J. of Agr. Econ. Res., (1988):11-18.

Sarris, A. H., "European Community Enlargement and World Trade in Fruits and Vegetables," Amer. J. Agr. Econ., 65(1983):235-46.

____________, "Empirical Models of International Trade in Agricultural Commodities," in A. McCalla and T. Josling (eds.) Imperfect Markets in Agricultural Trade, Montclair, N.J.: Allenheld, Osmun and Co., 1981.

Segerson, K. and T. Mount, "A Non-Homothetic Two-Stage Decision Model Using AIDS," Review of Econ. & Stat., (1985):630-639.

Suryana, A., "Trade Prospects of Indonesian Palm Oil in the International Markets for Fats and Oils," Ph.D. dissertation, North Carolina State University, 1986.

Theil, H., Principles of Econometrics, New York: John Wiley and Sons, 1971.

Thompson, R. L., "A Survey of Recent Developments in International Agricultural Trade Models," BLA-21, USDA, ERS, September 1981.

______________, "Summary Comments," Elasticities in International Agricultural Trade, Proceedings of International Agricultural Trade Research Consortium meeting, Dearborn, Michigan, 1987 (Westview Press, forthcoming).

Wells, Gary, "The Impact on Wheat Import Patterns from the Entrance of the United Kingdom into the European Economic Community," Ph.D. dissertation, Dept. of Econ. and Business, North Carolina State University, 1977.

Winters, L. A., "Separability and the Specification of Foreign Trade Functions," J. Int. Econ., 17(1984):239-263.

Table 1

Test Results for the People's Republic of China

Separable Country	Homotheticity $\beta_i=0\ \forall_i$	Separability $\delta_i=0\ \forall_i$	Homotheticity and Separability $\delta_i=0,\ \beta_i=0\ \forall_i$
	d.f. (2,17)	d.f. (2,17)	d.f. (4,17)
I. Australia			
a. U.S., Canada[b]	6.510*[a]	2.998	9.536*
b. U.S., Argentina	6.102*	0.768	4.469*
c. Canada, Argentina	3.704*	4.195*	7.474*
II. Argentina			
a. U.S., Canada	2.696	1.322	4.568*
b. U.S., Australia	1.851	2.244	3.515*
c. Canada, Australia	4.146*	1.521	5.282*
III. Canada			
a. U.S., Australia	2.323	4.412*	10.232*
b. U.S., Argentina	3.358	1.119	5.435*
c. Australia, Argentina	1.039	0.548	0.530
IV. U.S.			
a. Canada, Australia	11.370*	5.150*	26.610*
b. Canada, Argentina	3.355	4.353*	14.236*
c. Australia, Argentina	0.995	0.387	0.511

[a]Denotes statistical significance at the 5 percent significance level.

[b]Import sources included in the estimations.

Table 2

Test Results for Brazil

Separable Country	Homotheticity $\beta_i=0 \ \forall_i$	Separability $\delta_i=0 \ \forall_i$	Homotheticity and Separability $\beta_i=0, \delta_i=0 \ \forall_i$
	d.f. (1,11)	d.f. (1,11)	d.f. (2,11)
I. Argentina			
a. U.S.[b]	1.778	-0.936	2.656
b. Canada	-1.907	2.206*	2.444
II. Canada			
a. U.S.	1.645	-0.817	2.643
b. Argentina	0.510	-1.896	5.939*
III. U.S.			
a. Canada	-3.175*[a]	3.750*	7.247*
b. Argentina	0.428	-1.670	5.204*

[a]Denotes statistical significance at the 5 percent level of significance.

[b]Import sources included in the estimations.

Table 3

Test Results for Egypt

Separable Country	Homotheticity $\beta_i=0 \;\; \forall_i$	Separability $\delta_i=0 \;\; \forall_i$	Homotheticity and Separability $\beta_i=0,\ \delta_i=0 \;\; \forall_i$
	d.f. (1,10)	d.f. (1,10)	d.f. (2,10)
I. Argentina			
a. U.S.[b]	1.150	-0.641	0.762
b. EC	-1.318	2.095*	2.370
II. EC			
a. U.S.	4.140*[a]	-2.122*	9.744*
b. Australia	-0.892	-0.946	3.449
III. U.S.			
a. Australia	0.642	-1.805	2.403
b. EC	-1.620	2.476*	3.199

[a]Denotes statistical significance at the 5 percent level of significance.

[b]Import sources included in the estimations.

Table 4

Tests Results for the U.S.S.R.

Separable Country	Homotheticity $\beta_i=0, \forall i$ d.f. (3,24)	Separability $\delta_i=0, \forall i$ d.f. (3,24)	Homotheticity and Separability $\beta_i=0, \delta_i=0, \forall i$ d.f. (6,24)
I. Argentina			
a. Australia, Canada, EC[b]	9.075*[a]	5.304*	6.863*
b. Australia, Canada, U.S.	6.512*	5.299*	6.079*
c. Australia, EC, U.S.	8.530*	5.005*	6.600*
d. Canada, EC, U.S.	9.257*	4.582*	6.563*
II. Australia			
a. Argentina, Canada, EC	16.392*	3.016*	9.452*
b. Argentina, EC, U.S.	15.880*	2.352	8.859*
c. Argentina, Canada, U.S.	10.200*	1.538	6.030*
d. Canada, EC, U.S.	15.251*	3.012*	8.850*
III. Canada			
a. Argentina, Australia, EC	12.917*	4.995*	8.847*
b. Argentina, Australia, U.S.	10.731*	2.974	8.063*
c. Argentina, EC, U.S.	16.295*	4.931*	11.425*
d. Australia, EC, U.S.	11.631*	5.979*	9.661*
IV. EC			
a. Argentina, Australia, Canada	1.288	3.264*	2.231
b. Argentina, Australia, U.S.	10.429*	1.942	6.049*
c. Argentina, Canada, U.S.	12.016*	0.719	6.444*
d. Australia, Canada, U.S.	5.418*	3.535*	4.430*
V. U.S.			
a. Argentina, Australia, Canada	1.769	4.838*	3.619*
b. Argentina, Australia, EC	13.094*	4.348*	7.981*
c. Argentina, Canada, EC	15.038*	2.930	9.075*
d. Australia, Canada, EC	14.348*	4.789*	9.758*

[a]Denotes statistical significance at the 5 percent significance level.

[b]Import sources included in the estimations.

Table 5

Test Results for Japan

Separable Country	Homotheticity $\beta_i=0 \ \forall_i$	Separability $\delta_i=0 \ \forall_i$	Homotheticity and Separability $\beta_i=0, \delta_i=0 \ \forall_i$
	d.f. (1,21)	d.f. (1,21)	d.f. (2,21)
I. Canada			
a. U.S.[b]	4.492*[a]	-2.522*	17.9252*
b. Australia	2.683*	-2.588*	3.6529*
II. Australia			
a. U.S.	4.517*	-2.516*	16.938*
b. Canada	-7.667*	5.397*	35.856*
III. U.S.			
a. Australia	2.900*	-2.705*	4.207*
b. Canada	-8.816*	6.075*	54.062*

[a]Denotes statistical significance at the 5 percent significance level.

[b]Import sources included in the estimations.

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Number	Title	Author(s)	Send correspondence or requests for copies to:
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